FEDERATION OF AUSTRALIAN SCIENTIFIC
AND TECHNOLOGICAL SOCIETIES

Science and Technology for the Social, Environmental and Economic Benefit of Australia

Australian Science: Investing in the Future

Investing in the Future

2002 edition

Vision for Australia in the 21st Century

The nation will:

Educate our population to provide a high level of scientific and mathematical understanding;

Use Australia's terrestrial and aquatic environments responsibly within scientifically established limits, and ameliorate past degradation;

Stabilise our greenhouse gas emissions to meet our global responsibilities, by implementing world's best practice in energy efficiency;

Generate wealth from innovative industries producing value-added products and services that are both globally competitive and sustainable;

Be highly networked with an efficient regional transport system and universal access to high quality telecommunications; and

Provide healthy lives and a long life expectancy for all Australians.

To achieve these goals we will need an increased and sustained investment in science and technology.

By 2020 the achievement of this vision will place Australia in the top third of OECD nations in international comparisons of economic, social, scientific and educational performance.

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President's Foreword

Recent years have seen a profound change in the way that science and technology are viewed. There is a national desire for Australia to be of world class in these areas, to capture the benefits of Australian innovation and to take nationally important decisions in the light of sound scientific evidence assessed by a scientifically literate community. There is also strong economic evidence that investment in scientific R&D yields a healthy rate of return.

One of the promising signs in Australia in this period is that both major political parties have increased their commitment to science and technology. The commitment has been accompanied by some modest (but welcome) increases in funding.

The missing ingredient is a commitment to a long-term strategy for Australian science and technology, a vision that would allow it to serve its rightful place as a driver of the economy and solution to our environmental problems. Science and technology lie at the heart of Australia's national development. They help establish new industries; enable existing industries to develop new and improved products; and provide a healthy environment.

The national strategy hovers tantalisingly just beyond our reach. We have parts of it, but not the whole. Some industries, some sectors, some government portfolio areas have a clear sense of direction, but the country as a whole does not. There is a view across the nation that Australia needs a national vision – an idea of where it wants to position itself over the next decade - and that market forces alone cannot ensure the nation's continuous improvement.

Visions and strategies are not just creatures of Government. The community generally and the sectors that make up the economy need to believe in and support a national sense of direction. The role of Government is to create the structures from which a strategy will emerge, and to lead and promote it once it is in place.

The strategy needs to be supported by adequate funding, greater funding than we have ever committed to science. Australia always trails behind the main bunch in any international comparison of modern economies. We come eleventh, or fifteenth, or twenty-third; behind the leading countries of Europe, Asia and North America. Such a position would be intolerable in sport, but it seems to be accepted in science, a far more important measure to our prosperity and survival.

While Australia has made modest increases in funding, governments overseas have not been standing still. The US, the UK, Japan, countries in the OECD - all have success stories in promoting the level of R&D activity that Australia could successfully emulate. Both systemic and fiscal reform is called for.

The policies FASTS puts forward are the collective view of 60,000 working scientists and technologists. This is our attempt to change the national direction, to put in place the long-term strategies that will reap rewards for both the current generation and our children.

Professor Chris Fell

President, FASTS

September 2002

Ten Strategies for Immediate Change

FASTS commends to Government ten strategies that will provide immediate scientific and technological contributions to the six national goals presented in this document.

- Build on *Backing Australia's Ability*, to increase Australian GERD and place our R&D investment within the top third of OECD countries ***(Strategy 11.1.1)***.
- Provide incentives for private sector R&D by simplifying taxation regulations; by introducing a sliding scale of tax deductibility that rewards higher R&D intensity; and by reducing capital gains tax for longer-term venture capital investments ***(Strategy 5.1.1*** *and* ***Strategy 5.2.1).***
- Introduce 100 new jointly funded postdoctoral positions in industry ***(Strategy 4.2.1).***
- Rejuvenate and restructure higher education, by providing more resources; by changing relative funding models to increase support for science and technology; and by providing incentives for universities to cooperate and provide access to all major disciplines in teaching and research in the major population centres ***(Strategy 10.1.1, Strategy 10.2.2*** *and* ***Strategy 10.4.1).***
- Introduce a new Parliamentary Fellowships Scheme to provide high-level scientific advice to Parliament ***(Strategy 16.4.1).***
- Encourage commercialisation by, for example, allowing public sector scientists and technologists the option of equity in spin-off companies arising from their work ***(Strategy 3.4.2).***
- Encourage science and mathematics education, and remove disincentives for science and mathematics teaching, by reducing the HECS rate for science and mathematics ***(Strategy 9.2.1).***

There are many other innovative ideas in the following sections, which will be important over the long term.

The FASTS statement of Principles

1. **Investing in science and technology is the key to a high quality of life and a healthy economy.**

2. **Education and training in science and mathematics underpins a knowledge-based, high-wage economy.**

3. **Australia must nurture, attract, and retain an internationally competitive workforce.**

4. **Support of the nation's science and technology infrastructure in universities and government research agencies is a public responsibility.**

5. **The nation has a particular responsibility to support long-term basic research because it stimulates innovation.**

6. **Industry and government have a joint interest to invest in applied research and development.**

7. **A national science policy is essential for stability of funding, long-term planning and whole-of-government implementation.**

Scientific State of the Nation

Australia's science and technology landscape has changed significantly in recent years, with a bipartisan acknowledgement that investment in science and technology is a major driver of the nation's economic, social and environmental wellbeing. A range of investigations, reviews and policy positions have contributed to this process:

- The Innovation Summit and the subsequent Implementation Group Report;
- *A Chance to Change*, the review by Chief Scientist Robin Batterham;
- The implementation of recommendations from these two inquiries in the Coalition Government's *Backing Australia's Ability* (BAA);
- The release of the Labor Party's *Knowledge Nation* paper;
- The increasing involvement of State Governments in science policy and funding;
- The review of Government agencies' external earnings targets;
- The Higher Education Review;
- The National Research Priorities process; and
- The review of Business Expenditure on Research and Development (BERD).

Science and technology are now firmly on the national agenda, and are coordinated broadly through the Prime Minister's Science, Engineering and Innovation Council (PMSEIC). FASTS has contributed to this process by:

- Making submissions to these major inquiries;
- Playing an active role in PMSEIC;
- Taking science to all Parliamentarians through "Science meets Parliament" Day;
- Frequent discussions with Government, the Opposition and the public service;
- Holding nationally televised FASTS' Forums on key issues; and
- Developing and disseminating FASTS' policies.

Despite operating under increasingly difficult circumstances, Australian science continues to punch well above its weight, producing 2.7% of the world scientific literature[1]. This in turn provides us with an excellent opportunity to leverage global R&D. Australia is at a crucial stage when vital decisions will soon be made on future government commitments to investing in science and technology.

However, there are well-founded concerns over the nation's recent performance compared with our major international competitors. The most worrying of these is our performance in BERD (Figure 1). Following a sustained period of growth since the mid-1980s, Australia's BERD has slumped since its peak in 1995/96 (0.86%) to levels not seen since the early 90s (0.64% in 1999/2000). 2000/2001 saw a modest increase to 0.72%[2], still well below the peak and significantly below our international competitors, who in some cases exceed 2%.

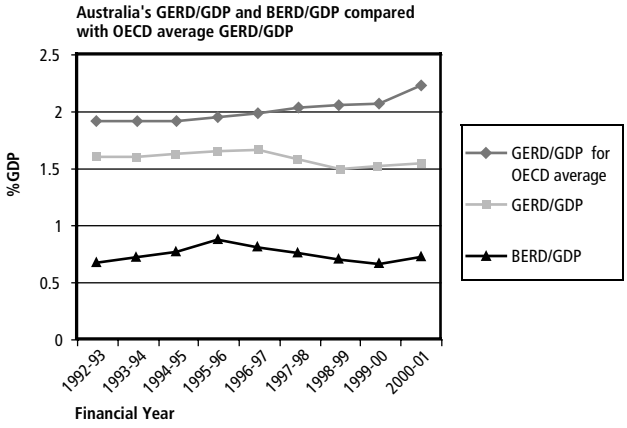

Figure 1. Time series of Australia's BERD/GDP and GERD/GDP compared to OECD average of GERD/GDP[3]. GERD is the sum of the R&D invested in the Business, Government and Higher Education sectors.

1 Linda Butler: "Monitoring Australia's Scientific Research", Australian Academy of Science, October, 2001.

2 Australian Bureau of Statistics publication series 8104.0

3 Australian data from Australian Bureau of Statistics publication series 8104.0 and 8112.0; OECD data from Group of Eight website: www.go8.edu.au.

Gross Expenditure on Research and Development (GERD) is another important comparator where Australia is falling behind. Figure 1 shows the latest data available for Australia and the OECD average.

Despite a slight increase in BERD in 2000/01, the corresponding GERD level of 1.53% is still less than that achieved 4 years ago (1.66%). It is therefore critical that the private sector, as well as State and Federal governments, significantly improve their R&D investment.

Higher Education is one area in which the level of public spending has not matched inflation or growth in the economy and where there is increasing reliance on private (student) funding – one of the highest such levels in the OECD[4] (Section 10). This sector is continually being required to produce more with less, and the present under-resourcing will harm our future capacity both to educate the next generation of scientists and technologists, and to carry out research. Our belief is that Commonwealth Government funding should be increased to this sector, and that the current review provides the right opportunity.

2001 saw the start of BAA - the most significant Federal Government initiative in science and technology during the past decade. The full impact of BAA has yet to be felt as the bulk of the $3 billion funding over five years is back-end loaded.

BAA is only the first step needed in a sustained process to ensure Australia's future international competitiveness. Before BAA, Australia's investment in knowledge in 1998 (Figure 2) was well behind our major international competitors, and we were ranked 14th - considerably below the OECD average. More recently, Australia has slipped from 11th in 2000 to 13th in 2002 in the world competitiveness index[5] with some notably smaller economies (Sweden, Ireland, the Netherlands, Canada, Hong Kong and Finland) above us on this overall indication of national standing.

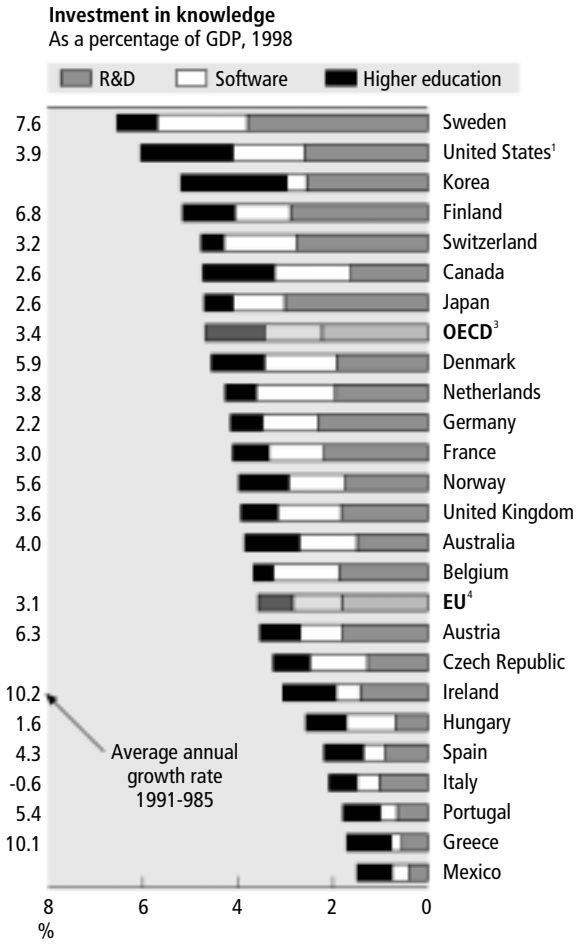

Figure 2. Investment in knowledge as a percentage of GDP, 1998[6].

FASTS is looking forward to the next step beyond BAA, and to other government and private sector initiatives that will improve Australia's economic performance and societal outcomes through science and innovation. This document is a resource of ideas as to how our vision for the future can be realised.

4 *International Comparative Higher Education Finance and Accessibility Project*, www.gse.buffalo.edu/org/IntHigherEdFinance

5 World Competitiveness Yearbook, http://www02.imd.ch/wcy/ranking/

6 OECD Science, Technology and Industry Scoreboard 2001 – Towards a knowledge-based economy.

1 National vision and priorities

Australia's science and technology sector has the potential to bring major social, economic and environmental benefits to all Australians. It is the cornerstone of FASTS' vision for a knowledge-based, high-wage path towards achieving our national objectives.

To enable science and technology to fulfil this important role, Australia must first develop an agreed national vision to define our national priorities. Broad thematic objectives in science and technology and discipline-based priorities will flow from that vision.

POLICY 1.1
Australia needs a national vision to focus our science, so we maximise the benefits to the country.

Strategy 1.1.1
FASTS will contribute to the determination of a national vision for Australia, based on the six goals in this document.

Strategy 1.1.2
FASTS will advocate a knowledge-based, high-wage path towards achieving our national vision.

Because government dominates the funding of many research and education sectors, it is able both to mediate and to implement national priorities. In 2002 the Federal Government took on the responsibility for establishing a national priority-setting process. FASTS supports the Government's broad consultative approach, and believes that the benefits of priority-setting will only be achieved if a whole-of-government process is used to establish a long-term plan for science and technology.

POLICY 1.2
Government has a central role to play in establishing a national vision, and to coordinate a national science policy through the setting of research priorities.

Strategy 1.2.1
A whole-of-government approach is required to establish effective long-term priorities over periods approaching a decade.

FASTS supports the selection of very broad research priorities that reflect Australia's competitive advantage or unique geo-scientific position, or which might address deficiencies in Australia's scientific, educational, economic or environmental framework. These priorities should encompass up to five broad themes to ensure that important issues are included, while avoiding blanket coverage of all areas of science.

POLICY 1.3
Government should invest strategically in areas of national priority to exploit strengths or remedy weaknesses in Australia's scientific, educational, economic and environmental base.

Strategy 1.3.1
FASTS and its Member Societies will provide advice on discipline-based inputs that contribute to the national priorities.

Strategy 1.3.2
Up to five priorities in science and technology should be established with additional input from the social sciences and the humanities.

History shows that it is impossible to predict many spectacularly successful discoveries that are founded upon decades of fundamental research (Section 11). Through globalisation and scientific networks, researchers can readily tap into advances elsewhere, provided that the fundamental scientific capacity exists in the country to exploit the information and offer exchange of knowledge in return.

It is therefore important to ensure that Australia supports a range of fundamental research programs at a high level, as well as the international linkages that provide rapid access to new developments. In order to ensure that serendipitous discoveries are not unduly prejudiced, FASTS advocates that priority-setting be tapered to apply more to strategic and applied research rather than to fundamental research. This implies a differentiated role for priority-setting between the various government-funded research programs to support a pluralistic approach to Australian research funding.

FASTS recommends that mid-term reviews be undertaken to provide continuity into the next

priority-setting phase. The outcomes should be assessed using broad socio-economic indicators in addition to published work, and publicly-funded research programs should be required to report on the outcomes and the extent of priority research funded by their institution.

POLICY 1.4
Priority-setting should be used to influence strategic and applied research more than fundamental research.

Strategy 1.4.1
Support wide ranging, internationally-networked fundamental research to underpin long-term priority goals.

Strategy 1.4.2
Allow government-funded research organisations to set their own priorities within a national priority framework.

Strategy 1.4.3
Monitor the priority process by publicly reporting on a broad range of indicators from government-funded research programs.

2 Science coordination

Australia requires a wider "whole-of-government" approach to coordinate the national research effort because of the pervasiveness of science to almost all policy areas, and because many issues involve Federal, State and Territory Governments.

National scientific priorities and funding goals should be set by an interactive process between the Commonwealth, States, and Territories (e.g. through COAG - the Council of Australian Governments), and should include high level scientific advice (Section 16).

POLICY 2.1
A whole-of-government approach to science and technology must include Federal, State, Territory and Local Governments.

Strategy 2.1.1
FASTS will contribute scientific and technological advice through its membership of PMSEIC, its interaction with ministers and the newly appointed House of Representatives Standing Committee on Science and Innovation.

FASTS supports a plurality of funding mechanisms. This is a feature of a mature marketplace. Different organisations have different approaches, and the diversity of funding sources will maximise Australia's capabilities ranging from short-term, commercial, applied science and technology; to long-term, public good, basic research. It is less likely that gaps will occur under such a pluralistic system than under a single, centralised funding authority.

However, there have been occasions when infrastructure support becomes the core of a 'bidding war' between states or institutions over facilities or research centres. This is sometimes driven by a desire to leverage additional Federal funding. A lack of coordination may result in distortions to the research system.

POLICY 2.2
Within a pluralistic system, the Federal Government should take a lead role in coordinating the efficient development of national and collaborative research structures.

Strategy 2.2.1
The Federal Government should act as a broker and develop incentives to coordinate collaborative research and the provision of national infrastructure.

As the peak body on science and technology issues chaired by the Prime Minister, PMSEIC plays an important advisory and coordinating role and provides a unique interface between science and government.

POLICY 2.3
FASTS supports PMSEIC as playing a key coordinating role for Australian science.

Strategy 2.3.1
FASTS, as a member of PMSEIC, will harness the expertise of its 60,000 members to contribute to the discussion of science and technology issues.

3 Enhancing research commercialisation

Today's research underpins the industries of the future, which in turn create wealth and jobs. Australia must ensure that it captures the full commercial benefits of its research results. Little has changed in recent years[7] and we still need to develop:

- More proactive attitudes towards commercialisation of research outcomes;
- Improved government programs to support R&D in industry;
- Better business skills for scientists;
- Easier movement of scientists between industry and public sector research; and
- More incentives to encourage research scientists to commercialise their work.

These shortcomings have been recognised by the Government in BAA, but a widespread cultural change is still required across parts of industry, the general population, the public sector and the country's scientists and technologists.

POLICY 3.1
Long-term strategies are needed to change cultural attitudes in Australia to encourage innovation.

Strategy 3.1.1
FASTS will encourage its Member Societies to become strongly involved in the Innovation Awareness Program.

Strategy 3.1.2
Publicise activities of successful high-tech companies and innovator role models.

Basic and long-term research is important in driving innovation. Many aspects of the present global commercial environment act counter to this process:

- Increasingly rapid shifts in company structures and movements in personnel in response to fast-changing circumstances (the average Business Council of Australia CEO membership is currently 4.2 years[8]);
- Emphasis on short-term profits, stock options for CEOs and senior staff, and shareholder gains;
- Increasing globalisation and foreign takeovers that often repatriate R&D overseas; and
- Stock market collapses that undermine long-term investor confidence in high technology industries.

We need long-term incentives and a cultural change to correct this trend.

POLICY 3.2
Priority should be given to a longer-term approach to investment in industrial R&D.

Strategy 3.2.1
Government programs should encourage proposals that involve longer-term research commitments.

Strategy 3.2.2
Provide stable policies that attract long-term overseas investment in R&D.

On a company level, greater provision should be made for the holding of joint positions in public research organisations and on company boards. Transfer of scientists between the public and private sectors should be encouraged.

Many scientists and research managers recognise their lack of familiarity with the commercialisation process and the way industry operates. There is often a scarcity of expertise in the commercialisation arms of universities and other research organisations, and a lack of good advice to researchers with potential new products.

POLICY 3.3
Scientists and technologists should have the skills and ability to move freely between industry and public sector research institutions.

7 *Scientists Commercialising Their Research*, T. Gascoigne and J. Metcalfe, FASTS Occasional Paper No. 2, 1999.

8 Hugh Morgan, quoted in The Australian, p25, 14 June 2002

Strategy 3.3.1
Foster commercial awareness and build the commercial skills of scientists and research managers.

Strategy 3.3.2
Encourage government research organisations and industry to remove barriers to free movement, such as high salary differentials, terms of employment and superannuation.

Strategy 3.3.3
Make units on commercialisation and innovation accessible to undergraduate and post-graduate science and technology students, and provide science units for students undertaking business, management and commerce degrees.

Strategy 3.3.4
Combine university technology-transfer arms to concentrate scarce expertise, with scientists able to approach any of them for advice.

The incentive systems in universities and particularly in government research organisations do not adequately reward commercial activities. Commercialisation achievements should be recognised in promotion cases, and researchers should be allowed the option of equity in the commercial outcomes.

POLICY 3.4
Scientists in any organisation should receive incentives for commercialising their research.

Strategy 3.4.1
The criteria for promotion and appointment in research organisations should recognise contributions to commercial activities.

Strategy 3.4.2
Reward public sector scientists and technologists with, for example, the option of equity if their work is commercialised.

FASTS advocates that intellectual property rights be granted to the performing organisation, while ensuring that incentives for individual researchers or research teams exist by sharing the rewards. A set of indicative models should be drawn up so that there is a consistent approach throughout Australia on the reward-sharing arrangements between scientists and their research organisations.

POLICY 3.5
Intellectual property should be retained by the research organisation, while researchers should have a share of the rewards.

Strategy 3.5.1
The Government should establish indicative models for the intellectual property benefits arising from publicly-funded research.

4 A Government role for R&D incentives

Corporate research and development is a crucial component of the wealth creation process, and is essential to maintain international competitiveness.

> *"Investments in R&D have high rates of return. The social rate of return which may be close to 50%, exceeded the high private rate of returns, of 20 to 30%, by a considerable amount because of 'spillovers' - benefits that accrue as other researchers make use of new findings, often in applications far beyond what the original researcher imagined.*[9]*"*

These high returns for investment in R&D are repeated in numerous international studies, some of which place the social rate of return at over 60%[10]. There is clearly a strong incentive for both the nation and the private sector to benefit from this investment.

However, Australia's historically poor performance in private sector R&D has been well documented. Currently, Australian BERD is well behind our international competitors, and as a percentage of industry domestic product has slipped from 14th in the OECD 1997 to 20th in 1999 (Figure 4.1).

From a peak in 1996 (0.86%), Australian BERD fell dramatically to 0.64% in 1999/2000, recovering somewhat in 2000/2001 to 0.72%. Most other OECD countries consistently increased BERD as a percentage of GDP during the same period (Figure 4.2).

There is a key role for Government in improving this poor performance, by augmenting the measures currently in place under BAA.

FASTS supports the use of a balanced range of incentive schemes. These include:

- The use of enhanced tax deductibility and tax credits for genuine R&D investments;
- Improvements to mechanisms providinglinkages to university and government research sectors e.g. the R&D START scheme;
- Greater incentives for attracting long-term venture capital, including an internationally competitive capital gains tax system; and
- Augmented incubator schemes and measures to protect high technology start up companies from premature takeover.

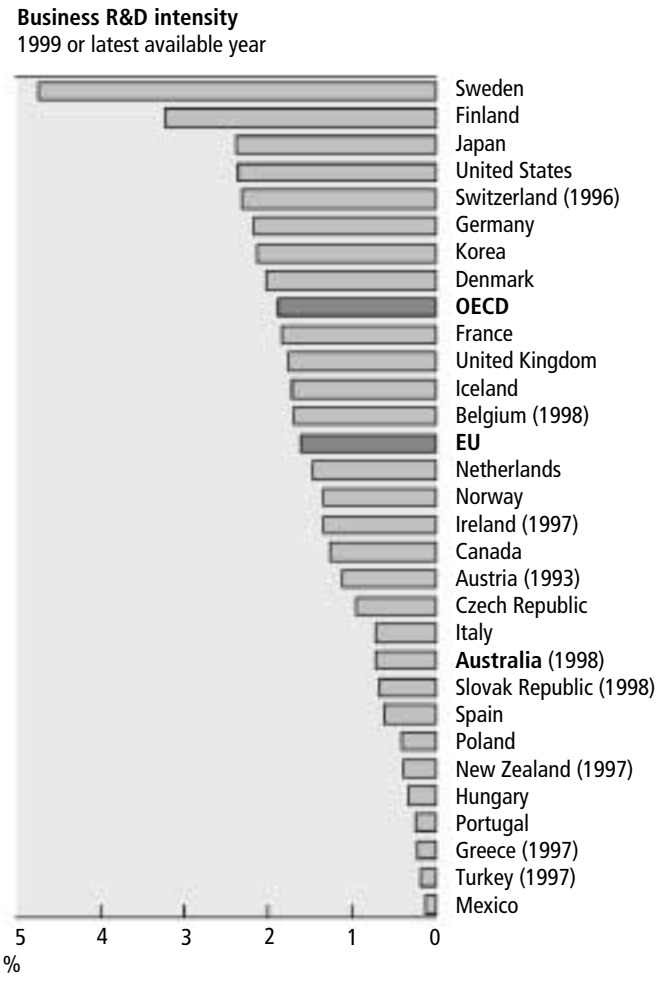

Figure 4.1 Business enterprise sector R&D expenditure as a percentage of domestic product of industry (1999)[11].

9 *Supporting R&D to Promote Economic Growth: The Federal Government's Role*, US President's Council of Economic Advisers, October, 1995.

10 Studies compiled by Professor Steve Dowrick, ANU, and presented at the Melbourne Institute Economic and Social Outlook Conference, April 4-5, 2002.

11 OECD Science, Technology and Industry Scoreboard 2001 – Towards a knowledge-based economy.

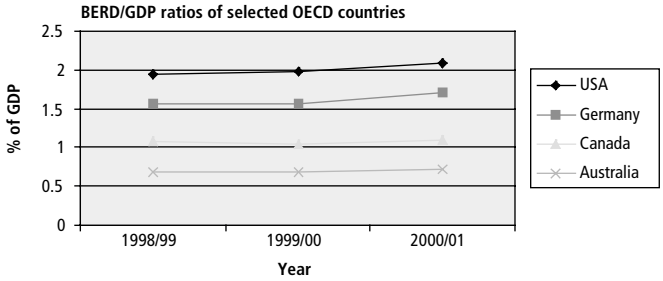

Figure 4.2 BERD/GDP ratios for selected countries[12].

FASTS has outlined such improvements through a combination of taxation and legal reforms (Section 5) and improvements to venture capital (Section 6). These policies should be further supported by other innovative incentives.

For example, FASTS proposes an extension of the present R&D START Scheme, which would make available 100 postdoctoral positions in industry each year. These positions would be funded in the same way as the R&D START Graduate Program, i.e. 50/50 by government and industry in open competition.

This proposal would enhance existing schemes by placing postdoctoral scientists with research project experience directly into private sector R&D programs (as opposed to raw graduates under R&D Start). They should be encouraged to build a career path in the company and eventually increase the level of scientific representation in the boardroom.

POLICY 4.1
Government should aim to lift BERD by providing innovative incentives for industry to invest in R&D.

Strategy 4.1.1
FASTS will advance our proposal for the introduction of 100 new postdoctoral positions funded jointly by government and industry.

Industry has been deterred from investing in R&D by frequent changes to incentives, and by the reduction in their value. Ideally these incentives should be applied under a long-term national science policy which recognises the role of such investment in strengthening Australian industry and commerce.

POLICY 4.2
Government incentives should be sufficiently simple and attractive to encourage R&D investment, and should be consistent to enable long-term planning.

Strategy 4.2.1
FASTS will encourage the introduction of long-term BERD incentives that are well targeted and cost-effective.

Government also has a role to encourage industries with common interests to set up research funding bodies via voluntary sector levies. These funding bodies can then consider specific research proposals from universities, government and private organisations that relate to generic areas of interest for the industry, rather than for proprietary applications.

This is a particularly important innovation for small to medium-sized enterprises (SMEs), which on their own may not be able to perform R&D requiring a high level of investment. The Rural Industry R&D Corporations are an appropriate model.

POLICY 4.3
Provision must be made for the R&D needs of SMEs to enable them to invest in and benefit from advances in scientific research and high technology.

Strategy 4.3.1
FASTS will strongly support the establishment and continuance of voluntary industry sector research bodies funded by internal sector levies, with support from government.

12 *Research and Experimental Development, Businesses*, 2000-01, ABS catalogue 8104.0.

5 Taxation and legal reform to stimulate R&D

Australia should be an attractive place to invest in high technology companies. In order to compete successfully, companies need a taxation and legal environment that encourages innovation and allows rapid responses to new ideas and consumer demands.

While these issues received considerable attention by the Innovation Summit Implementation Group[13], the Chief Scientist in *The Chance to Change*[14] and the Government in *Backing Australia's Ability*, FASTS believes further action is warranted if Australia's poor BERD performance is to be improved.

A. *R&D Tax Concessions*

Studies[15] indicate that compared to the original (1985) R&D tax deductibility of 150% at the 1985 company tax rate of 49%, the R&D deductibility at the current corporate tax rate of 30% would need to increase to 185% to return the same net tax benefit. The present 125% deductibility under BAA (with 175% for new R&D only in the year in which it is introduced) compares unfavourably with the earlier rates, and with overseas rates of deductibility, which in some cases reach 200%[16].

FASTS recommends that the present R&D tax concession be replaced by a sliding scale. When companies invest a higher proportion of their company turnover in R&D, they should be rewarded with a higher percentage deduction. For R&D intensity greater than an upper level of say 5%, the deductibility should be at least equal to the 175% upper BAA rate to be internationally competitive, while the lowest rate e.g. for less than1% R&D intensity, could attract less than the current 125% deductibility. Rather than simply rewarding companies in the year of the increased R&D level, the deductibility rate should be determined from the R&D percentage year-by-year.

POLICY 5.1
Australia's tax concessions for R&D should encourage 'BERD' and must be internationally competitive.

Strategy 5.1.1
Introduce a sliding scale of tax deductibility that rewards higher levels of R&D investment as a percentage of company turnover.

For companies that do not show a profit in their early development phase, BAA has replaced tax deductions with tax rebates in order to provide companies with an immediate tax benefit. This creates a favourable environment for high technology start-up companies that frequently do not become profitable for a number of years, and particularly benefits SMEs. However, the same sliding scale incentive to increase the proportion of R&D should apply to pre-tax companies.

Strategy 5.1.2
Introduce a sliding scale of R&D tax rebates that provide similar incentives to the proposed sliding scale of R&D tax deductibility.

B. *Capital Gains Tax*

The Capital Gains Tax (CGT) environment is very important to attract domestic and overseas investors in innovative projects. During its last term, the Government reduced CGT, which should encourage venture capital investment. This has made Australia's CGT regime more competitive, but we must ensure that this remains so.

Typically, new high-tech companies do not show profits for several years because of the need to reinvest in growth. As a result, venture capitalists can only reap returns by exiting the investment and realising capital gains.

A tapered CGT rate, reduced annually in proportion to the length of time the asset is held (as in the UK), would attract investment without destabilising either the long-term prospects for high technology industry (due to speculative movements of capital), or long-term social equity. This tapered rate should be strictly targeted to high technology industries.

13 *Innovation: Unlocking the Future*, Final Report of the Innovation Summit Implementation Group, August 2000.

14 *The Chance to Change*, Final Report by the Chief Scientist, November 2000.

15 Michael Johnson and Associates, submission to the Ralph Review on company taxation.

16 Singapore National Science and Technology Board: http://www.nstb.gov.sg/.

POLICY 5.2
Australia's CGT rates should be internationally competitive.

Strategy 5.2.1
Review the international competitiveness of Australia's CGT and adopt annually tapering rates to attract long-term venture capital.

C. *Company Takeover Laws*

Current Australian law allows the relatively easy takeover of start-up companies early in their development, particularly at a stage when cash flow is critical. This not only sees the loss of promising high technology companies to overseas interests and often shifts R&D effort offshore, but also acts as a disincentive to investors who may wish to realise long-term gains.

POLICY 5.3
Company law should nurture the development of start-up companies in the initial growth phase.

Strategy 5.3.1
FASTS will support laws aimed at limiting the premature takeover of Australian companies.

D. *Intellectual Property Protection*

IP rights are an important factor in protecting the research investment of knowledge-based economies. Currently, IP rights allow exclusive licensing of technology to organisations that take on the development of products requiring further investment; these rights thus act as an incentive to commercialise new technology. This should not necessarily be seen as a breach of competition policy, because without such exclusive intellectual property agreements, commercialisation may be compromised and development moved offshore where the Trade Practices Act cannot reach it.

FASTS believes that Australian innovations in scientific R&D are not always captured for the economic, environmental and social benefit of Australia; and nor are they always protected from exploitation by outside agencies. Australian scientists and technologists must protect their IP via the patent system and by appropriate strategic alliances with industrial partners. As such, IP protection should be an allowable R&D deduction.

Setting clear rules for IP protection is important, but a balance must also be achieved between commercial interests and reasonable community access to the work of publicly-funded research institutions. The government must acknowledge the risks to the research and innovation system that may result if the IP protection granted is too strong and non-exclusive licensing becomes too rare.

POLICY 5.4
Protection of our intellectual property is as important as its discovery and development.

Strategy 5.4.1
Allow patent costs to be eligible for the R&D tax concession.

Strategy 5.4.2
The government should ensure that the information derived from publicly-funded research is available at cost of transfer (see Policy 14.4.1).

Strategy 5.4.3
FASTS will promote awareness of IP protection among its members.

IP protection is vital if Australia is to realise the benefits of the work of its scientists and technologists, but FASTS believes that factual information in the natural sciences (for example, gene sequences) should not be patentable. Otherwise, key facts may become unavailable for wider wealth creation or for the greater public good. Patents, as originally intended, should be limited to technological processes and to methodology based on such facts.

POLICY 5.5
Patents should cover technical processes and methodology rather than factual information.

Strategy 5.5.1
FASTS will work against the patenting of factual information.

6 Venture capital

The amount of venture capital available in Australia is low by international comparisons. *"The amount we invest in the early stage of our venture capital market is small compared to international levels. Without access to early stage finance, businesses have little hope of developing an initial concept, developing prototypes or forming management teams to drive innovation forward."*[17] Australia's current international standing is well below the OECD (and EU) average, with little venture capital available for early stage development (Figure 6.1).

Investment in venture capital as a percentage of GDP, 1995-99

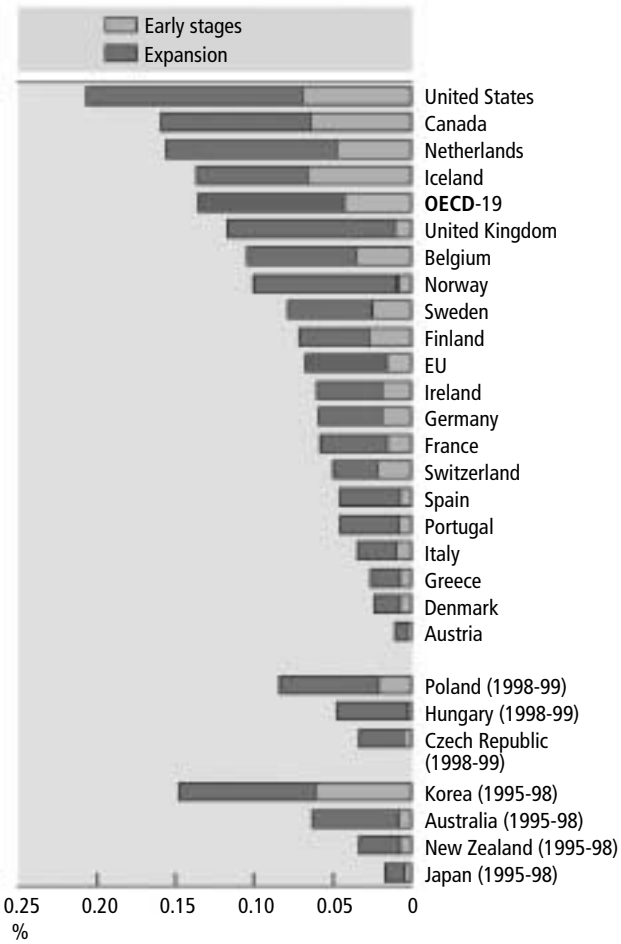

Figure 6.1 Investment in venture capital as a percentage of GDP, 1995-99[18]

17 *Innovation: Unlocking the Future*, Final Report of the Innovation Summit Implementation Group, August 2000.

18 OECD Science, Technology and Industry Scoreboard 2001 – Towards a knowledge-based economy.

A cultural change is needed in the Australian financial sector so that the long-term economic benefits of investing venture capital in high technology growth industries are recognised more widely. The Government has previously addressed this issue by introducing the Innovation Investment Fund (IIF) Program, the Pharmaceutical Industry Investment Program (PIIP) and the Pooled Development Fund (PDF) Program, all of which represent an excellent investment of taxpayers' money, and create growth areas of employment in Australia. These innovations have not, as yet, not been enough to keep pace with our international competitors.

The structural improvements outlined in Section 5 will not in themselves improve the accessibility of venture capital for innovative industries. Additional measures FASTS recommends include allowing R&D tax deductibility for interest and dividends earned by investors in trusts and/or funds set up specifically for investment in R&D and in high technology industries. FASTS supports the Government's establishment of competitive Pre-Seed Funds for universities and government research agencies. We believe this has the potential to make a significant contribution both to the culture within these institutions but also to developing commercial applications of value to the economy.

POLICY 6.1
The availability of venture capital in Australia should be comparable to our international competitors.

Strategy 6.1.1
FASTS will encourage a cultural change in the risk-averse nature of the Australian financial sector by promoting the wealth creation prospects of high technology industries.

Strategy 6.1.2
Interest and dividends earned by investors in trusts and funds set up specifically for investment in R&D and scientifically innovative projects should attract the R&D tax concession.

FASTS also recognises that while investment by large financial institutions such as the US pension funds may be needed to increase the range of venture capital available, it is important that this does not distort the mix of financial

institutions investing in high technology. Indeed, FASTS questions why Australia's superannuation funds are not playing a more important role as a source of domestic venture capital for start-up companies in the high technology sector.

POLICY 6.2
The Australian venture capital market should have an appropriately diverse mix of financial institutions, that invest for long-term gain.

Strategy 6.2.1
Encourage superannuation funds to play a greater role in the provision of venture capital for innovative industries.

7 Globalisation

Industrial R&D

The accelerating internationalisation of R&D by large companies, and the increased global competition to attract entrepreneurs, researchers and venture capital, challenge national policies that promote industry-science relationships. While the participation of foreign firms in national programs is increasingly important, and national research institutes and universities must be encouraged to internationalise their links with industry, there is a downside. R&D facilities can be lost offshore, IP developed in Australia can be exploited overseas, and our best researchers are often contributors to the brain drain.

Because of the size of many global multinational companies, countries like Australia are vulnerable to the whims of overseas boardroom decisions. The recent decline in BERD in Australia has had a significant international component. Nevertheless we should have a coordinated national approach to take advantage of globalisation to establish policy settings that achieve a higher level of R&D investment in this country (Sections 4, 5 and 6).

POLICY 7.1
Government should encourage multi-national companies to invest in R&D in Australia.

Strategy 7.1.1
Adopt a national approach to overseas R&D investment involving State and Territory Governments to prevent bidding wars.

Strategy 7.1.2
Introduce R&D incentives that compare favourably with international competitors.

Overseas Students

In the tertiary sector the educating of overseas students is now worth $3 billion/year – larger than some of our traditional exporting industries. This market must be protected by resourcing our universities adequately so they can attract high quality staff to maintain international competitiveness. But this must also be balanced against the needs of Australian students and other national priorities.

POLICY 7.2
Tertiary institutions should attract overseas students by offering internationally competitive degrees at both undergraduate and postgraduate levels.

Strategy 7.2.1
Tertiary institutions should incorporate internationally attractive courses while satisfying domestic student demands and priorities.

Strategy 7.2.2
The Commonwealth Government should increase funding to universities to attract and retain the best teachers and researchers.

Leveraging International Research

Australian research has long been a highly successful, highly globalised activity. Australia presently produces 2.7% of the world's research publications, and 30% of papers published by Australian institutions have international co-authorship[19].

Scientific progress depends crucially on the free and timely exchange of ideas, information and knowledge. Improving our investment in international networks will be repaid many times over by access to overseas expertise in exchange for knowledge generated in Australia.

Present schemes for international exchange funded by agencies such as DEST operate successfully, but are limited by resources. There should be a substantial expansion of the IPRS scheme, and postgraduate students supported through this scheme should be provided with both a full fee-waiver and a realistic living allowance. Immigration restrictions on the appointment of postdoctoral workers in Australia are limiting the international mobility of young scientists and should be reviewed.

POLICY 7.3
Australian researchers should be encouraged to participate in international networks, and overseas researchers should be encouraged to work in Australia.

19 Linda Butler: "Monitoring Australia's Scientific Research", Australian Academy of Science, October, 2001.

Strategy 7.3.1

Expand international scientific exchange schemes operated by public funding agencies.

Strategy 7.3.2

Encourage public and private sector organisations to provide opportunities for their scientists to work and study overseas.

Strategy 7.3.3

Provide support for postgraduate students and other young scientists to enable them to attend international conferences and visit overseas laboratories.

Strategy 7.3.4

Review visa and migration arrangements to remove regulatory impediments to visiting scientists.

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8 Investing in people

The nation's greatest asset in a modern, high technology society is a highly educated and inventive population. Nurturing, attracting and retaining people with scientific and technological knowledge is an important investment in this asset. Australia is currently at risk of losing future opportunities by not investing adequately in its people.

The number of qualified scientists and technologists entering Australia has, by some estimates, exceeded the number of those leaving. However, these estimates do not take into account issues of quality, and whether the newcomers have the skills and experience to replace Australians leaving for overseas. By contrast, studies such as that carried out by the Australian Mathematical Society[20], show that the brain drain is indeed real.

POLICY 8.1
Government should maintain detailed studies of the trends and capacity in Australia's scientific and technologically trained population.

Strategy 8.1.1
Monitor net changes in migration taking into account the level of qualifications, experience and employability of scientists and technologists.

Strategy 8.1.2
FASTS and its Member Societies will assist by monitoring net migration trends and demand within their respective disciplines.

Australia is losing the capacity to educate future generations in science and mathematics, with a worrying trend towards fewer students and fewer educators in the enabling sciences - physics, chemistry and mathematics. The trend away from science in schools (Section 9) has a flow-on effect in universities, as the decrease in the supply of students leads to a decline in the number of staff teaching these subjects. The decline in the teaching capacity in higher education for the enabling sciences is summarised in Figure 8.1[21].

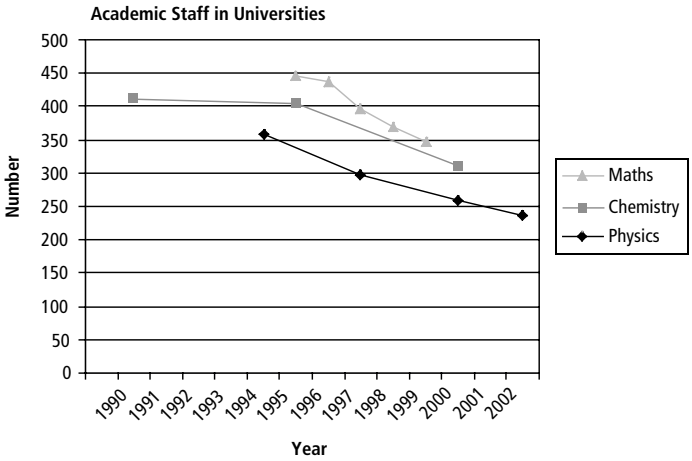

Figure 8.1 Number of university departmental staff in the enabling sciences, 1990 – 2000.

Tertiary science and mathematics education provides individuals with problem-solving and decision-making skills valuable in both private and public sector management, and leads to wider appreciation and understanding of scientific issues in the general community. People with these skills often choose to perform roles such as teaching or administration that lie outside their specific discipline areas.

Science is a good general degree. We need people with these skills even if they are not directly employed as scientists. The supply of graduates and postgraduates should not simply be limited to the number of positions available in science and mathematics. In view of the long lead time required to train such highly qualified people,[22] it is important to encourage them to look more widely at career options, and to address possible disincentives such as higher differential HECS levels.

POLICY 8.2
Graduates and postgraduates in science and mathematics are essential for the nation's economic, social and cultural well-being. The generic skills that they bring to research, business, industry and commerce should be recognised.

20 FASTS Occasional Paper 3.

21 Australian Institute of Physics - www.aip.org.au.

22 The age profile of academics and teachers, reported in discipline reviews (e.g. National Committee for Mathematics, *Mathematical Sciences: Adding to Australia*, 1996), shows that many will retire in the next 10 years.

Strategy 8.2.1
Establish whether there are financial barriers (eg HECS) to the study of science and mathematics; and if so, remove the barriers.

Strategy 8.2.2
Monitor changes in Australia's capacity to educate the next generation of scientists and technologists.

Strategy 8.2.3
FASTS and its Member Societies will assist by monitoring net trends and demand within their respective disciplines.

Strategy 8.2.4
Provide enough postgraduate scholarships for all first class honours applicants, and increase the postgraduate stipend for high-performing science and mathematics students.

Strategy 8.2.5
FASTS will encourage its Member Societies to publicise non-traditional professional pathways and encourage flexible options for new graduates.

Low salaries in Australia, inadequate support for research, reduced access to administrative and technical staff, and excessive teaching loads are driving Australia's best teachers and researchers overseas[23]. Australian salaries and conditions are no longer internationally competitive in many key disciplines. Other measures, such as the establishment of joint government-funded industry postdoctorals (Section 4), can help foster the creation of attractive career pathways to encourage the next generation of scientists and mathematicians.

POLICY 8.3
Australian scientists must be attracted and rewarded appropriately in keeping with their key role in national wealth creation.

Strategy 8.3.1
FASTS will continue to urge government to invest sufficient resources to provide internationally competitive salaries and conditions for researchers and educators in government employment.

Strategy 8.3.2
FASTS will recommend methods for improving the career opportunities for outstanding young researchers such as the government/industry postdoctoral scheme.

23 Mathematical Sciences in Australia: Looking for a Future. FASTS Occasional Paper 3, October 2000.

9 School science and mathematics education

A primary and secondary school education in science and mathematics provides the foundation for the effective understanding, dissemination and application of scientific knowledge in a modern technological society. A basic understanding of science also enables Australian citizens to make meaningful contributions and informed judgments about the benefits and risks of scientific, technological, and environmental changes.

As in many other OECD countries, in Australia there is a general trend away from the study of the sciences and mathematics. The number of secondary school students enrolling in science and mathematics has decreased against a trend of higher participation in other subjects. A report by the Australian Council of Deans of Science[24] notes that between 1989-1997 (when the total number of students increased by 3%), Australia-wide enrolments in Year 9 chemistry, physics, geology and biology dropped by 9%, 8%, 62% and 17% respectively. Figure 9.1 shows that enrolments in the enabling sciences (physics, chemistry and advanced mathematics) in particular have declined significantly during the last ten years.

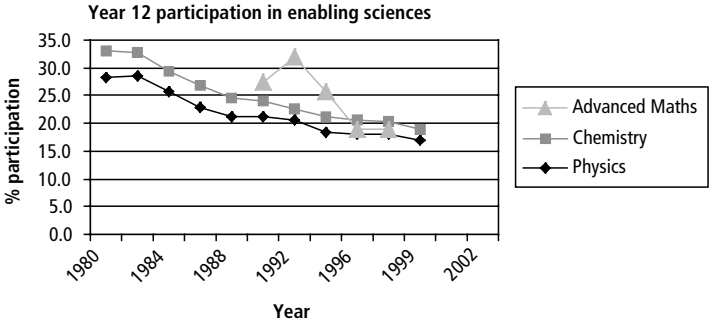

Figure 9.1 School science and mathematics enrolments by subject, 1991 - 97.[25]

Poor teaching conditions and lack of resources are likely contributors to this fall in participation, as well as the perceived gap between the earning potential of scientists and mathematicians compared with careers as doctors, lawyers and accountants.

Another major threat to high-quality science and mathematics education is the shortage of suitably qualified and positively motivated teachers, particularly in some metropolitan and rural/remote areas. Teachers of senior students should have a university major or higher degree in the relevant discipline, but current data indicate that many teachers are not appropriately qualified, and this situation is projected to worsen, particularly in the enabling sciences[26]. Incentives should be provided for primary and secondary teachers to develop their knowledge and abilities to the highest level, and to make teaching more attractive as a vocation.

POLICY 9.1
Science and mathematics teachers should have appropriate degree qualifications in the relevant discipline.

Strategy 9.1.1
FASTS will advocate better remuneration for teachers, and higher salaries for teachers who have higher-level qualifications in their discipline.

Strategy 9.1.2
Improve in-service and retraining schemes so science and mathematics trained teachers can increase their level of expertise.

Teachers with a science degree incur a higher HECS debt and thus have a lower take home pay than their peers in other disciplines. This is a strong disincentive for prospective teachers to undertake science and mathematics degrees.

POLICY 9.2
HECS liabilities for teachers should be at the lowest rate irrespective of discipline.

Strategy 9.2.1
FASTS will seek HECS equalisation to remove the higher debt burden for teachers in science and mathematics.

24 *Trends in Science Education*, I. Dobson and A. Calderon, Australian Council of Deans of Science, 1999.

25 Australian Institute of Physics - www.aip.org.au.

26 *Teacher Supply and Demand to 2004: Updated Projections*, B. Preston, Australian Council for Deans of Education 1998.

Science laboratories in many secondary schools are often in a deplorable condition, and well-equipped science rooms in primary schools are almost non-existent. New technologies offer exciting and innovative possibilities for teaching science and mathematics, but their adoption requires financial commitment to infrastructure, curriculum materials and support for teachers.

POLICY 9.3
Public funding of primary and secondary schools should provide the infrastructure needed for a quality science and mathematics education.

Strategy 9.3.1
FASTS will press for increased funding for facilities such as libraries, science teaching laboratories, computers and access to new technologies.

Many students lack appropriate course and careers advice, and the importance of studying science and mathematics for future employment in a broad range of careers is often not appreciated. The burden of career advice tends to fall on teachers, and thus they must be properly equipped to give advice on careers in science and mathematics.

POLICY 9.4
An increased participation in advanced level mathematics and science courses at senior secondary levels should be encouraged.

Strategy 9.4.1
Improve career awareness by providing career information for science and mathematics teachers.

School curricula must include challenging and relevant science and mathematics courses for students of differing ability and aspirations, particularly in senior years. Excellence and rigour should be the criteria for achievement in science and mathematics education at all levels, and curricula should be the best internationally as assessed against comparative data.

The present Australian science and mathematics statements and profiles for schools, developments in some year 11 and 9 Certificates, and the current preoccupation with measuring outcomes rather than improving curricula and resources are sometimes inconsistent with these goals. These impediments discourage good teachers who want challenging curricula and enough time and resources to teach well.

POLICY 9.5
Mathematics and science curricula must be of the best international standards, and schools must allow an appropriate amount of time for them to be well-taught.

Strategy 9.5.1
FASTS will support full and open consultation with both teacher organisations and its own professional societies in the development of coordinated national science and mathematics curricula.

10 Higher education

It is a public responsibility to fund universities so they can advance knowledge through research, and enthuse students through teaching. Increasingly, however, our higher education system is having to do more with less: teaching more students with a reduced share of total government expenditure, and relying more heavily on limited private funds through student fees (Figure 10.1). The result is a higher education system that is now seriously under funded. This is the key issue that must be addressed in the current Review of Higher Education.

The Commonwealth Government's investment in higher education has declined over the last six years, from about 0.73% GDP in 1996/97 to a projected figure of 0.55%[27] in 2002/03.

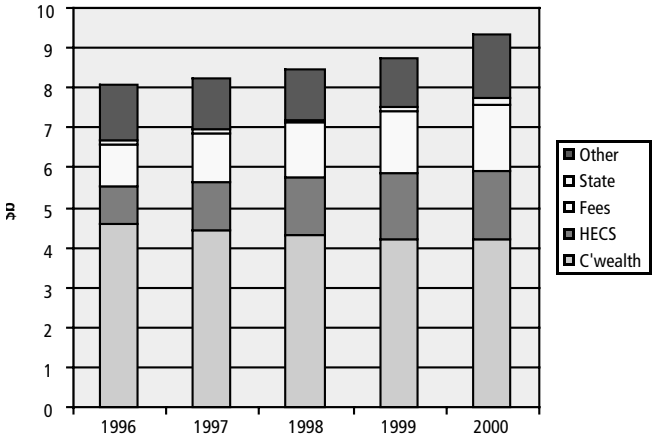

Figure 10.1 University funding from 1996-2000 (not adjusted for inflation)[28].

Student numbers have dramatically increased over the past decade, and student-to-staff ratios have risen steadily to levels exceeding those in primary or secondary schools[29] (19.9 in 2001 - Figure 10.2).

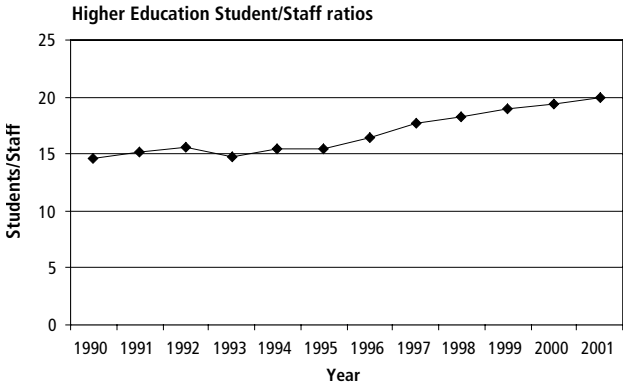

Figure 10.2 Higher Education Student/Staff Ratios: 1990–2000[30]

While productivity has increased through teaching more students per staff member, remuneration has decreased in relative terms, with university staff salaries falling as a function of average weekly earnings (Figure 10.3). This compromises the capacity to attract and retain the best teachers and researchers.

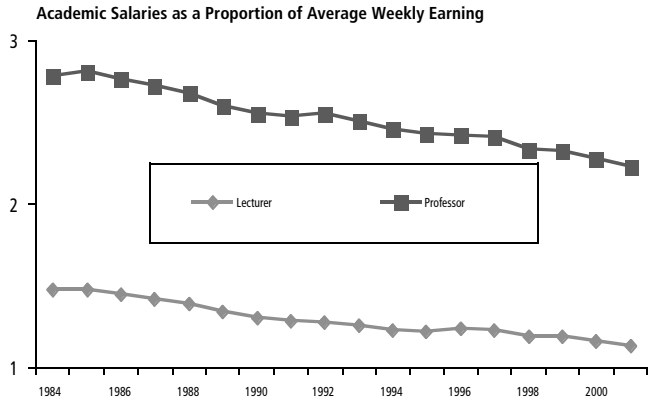

Figure 10.3 Academic Salaries as a Proportion of Average Weekly Earnings[31]

POLICY 10.1
Excellence in university teaching and research is a public responsibility and is essential to a modern economy.

27 Go8 policy statement for Federal Election, 2001.

28 *From DEST/DETYA selected higher education finance statistics, provided by AVCC 2002.*

29 *Figures for primary and secondary schools were 17.0 and 12.4 respectively in 2001, down from 17.3 and 12.6 respectively in 1999 (Schools Australia 1999, 2000, 2001. Australian Bureau of Statistics).*

30 *AVCC website - www.avcc.edu.au)*

31 *The Higher Education Finance Debate: Current Issues and Suggestions for Reform, Bruce Chapman, ANU, National Press Club Address, October 2001 (data are also on AVCC website).*

Strategy 10.1.1
Government must increase resources to address the chronic underfunding of the higher education sector.

Scientific advances derived from basic research contribute to applied science and innovation. Australia's basic research capacity exists mainly in the university sector. It is therefore essential for innovation that the research and teaching capability of our universities is among the best in the world.

Our universities are increasingly operating on outdated and failing equipment which has long since reached the end of its useful life, especially in the more expensive science and technology areas. Australia's capacity to sustain effective access to the global network of information and knowledge is diminishing, and maintenance of collections, libraries, and reference resources of national and disciplinary significance is being neglected.

The position in subjects like science is exacerbated by the relative funding models which often underestimate the true level required for high technology subjects.

POLICY 10.2
University infrastructure should be funded at a level that supports the nation's basic research capacity, and reflects the universities' role as primary provider of basic research.

Strategy 10.2.1
Place more emphasis on rewarding teaching and research output quality in formula funding for university infrastructure.

Strategy 10.2.2
Increase the resources available to science and technology subjects by changing relative funding models.

Reduced funding and higher teaching loads has meant a diminished capacity to perform research. It has been shown that a 10 per cent increase in teaching hours can cut research by 20 per cent.[32] FASTS maintains that the best scientific teaching environment is closely linked to strong research environments, and the best teachers are most actively involved in scientific research.

POLICY 10.3
A quality research environment enriches the quality of teaching.

Strategy 10.3.1
Reduce student/staff ratios and administrative loads to ensure that the teaching and research capacity of university staff is not compromised.

Declining funding levels in real terms have caused staff reductions, particularly in the expensive scientific disciplines. The result has been the disappearance of science and mathematics departments in an uncoordinated fashion, a process that has the potential to threaten the viability of these disciplines on a national level.

In what is rapidly becoming a differentiated university system, cooperative action to ensure geographic access to teaching and research in major discipline areas must be encouraged. Shared teaching and cooperation in under-represented disciplines should enable access to all science and mathematics subjects in every major population centre. Further, while core science and mathematics disciplines may be widely accessible to students at one location in the early undergraduate years, incentives could be introduced for students to relocate and continue study in that subject in later years. Similarly, staff who teach and have little opportunity for research or scholarship should receive support and encouragement to share research facilities elsewhere.

POLICY 10.4
Australia's university system should maintain a strong, internationally competitive, science and mathematics base over a range of disciplines.

Strategy 10.4.1
Provide incentives for universities to cooperate to provide access to all major disciplines in teaching and research in every major population centre.

Strategy 10.4.2
FASTS will encourage its Member Societies to monitor and facilitate collaboration in teaching and research.

32 Kevin Fox and Ross Milbourne, Economic Record, p. 256, September, 1999.

11 Investing in basic research

Basic research is crucial to economic performance because it is the source of a nation's ideas.

The US National Science Foundation found that 73% of scientific articles cited in patent applications in the US are based on research funded by American governments or foundations[33]. This emphasises the reliance of industry on public funding which provides the bulk of support for basic research. Without basic research, a country is forced to import costly new technologies, products and people.

Australia has a proud record of achievement in basic research and has in the past contributed strongly to the world scientific knowledge base (Figure 11.1). But there is growing evidence of a slump in the Australia's performance in the funding of science and hence in its research output. Between 1997 and 1999, Australia's commitment to basic research as a percentage of GDP fell from 0.45% to 0.40%. The latest OECD information is below shown in Figure 11.1.

Basic research as a percentage of GDP by sector of performance 1999

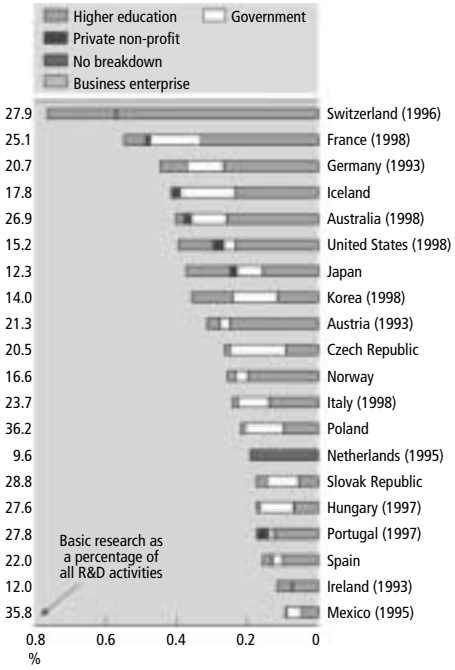

Figure 11.1 Basic research by sector as a percentage of GDP.[34]

33 *The Increasing Linkage Between US Technology and Public Science*, Francis Narin, CHI Research, 1997.

34 *OECD Science, Technology and Industry Scoreboard 2001 – Towards a knowledge-based economy.*

More recently, this decline may have been accentuated as significant increases have occurred in public investment in basic research by governments in the USA, Korea, Japan, France, Germany, UK and Canada as these countries recognise the importance of basic research to their economic development.

An awareness of our competitors' advantage in recent years, prompted by reviews within various research sectors, has seen a sea change in the way in which Australia perceives basic research. Both Labor's *Knowledge Nation* and the Coalition Government's *Backing Australia's Ability* indicated bipartisan support for an increase in the funding of basic research, and has led to the doubling of NH&MRC and ARC funding.

However, Australia's university infrastructure continues to erode (Section 10), and Australia's funding increases are modest compared to other countries. Australia needs to take the next step beyond BAA to continue the increase in public funding of basic research if it is not to fall further behind our international competitors.

POLICY 11.1.
Support for basic research at internationally-competitive levels is a public responsibility.

Strategy 11.1.1
Develop the next step following Backing Australia's Ability to position Australia's basic research funding and GERD within the top third of OECD countries.

Investing over a broad spectrum of basic research is important as we can never be sure which research will pay off. If, in the early 1960s, Australia had invested only in research supporting the agricultural, industrial or resource sectors, we would never have had today's world-class photonics industries, or been able to contribute to important discoveries on the HIV/AIDS epidemic. A range of state-of-the-art basic research allows us to tap into promising areas for the future via our global scientific networks.

A national policy has to strike a balance between market-driven research, public good research and basic research.

POLICY 11.2
Australia must maintain research across a range of disciplines, and strike a suitable balance between basic and applied research.

Strategy 11.2.1
FASTS will monitor the status of basic research through its Member Societies, and advise on the representation of key enabling disciplines.

12 ARC and NH&MRC

The ARC and NH&MRC support the major part of Australia's basic research. They provide research funding based on a national perspective and peer review, which encourages and recognises excellence. Research allocations should be informed by national priorities, but basic research should be less directed by national priorities than research with a more strategic and applied research focus.

POLICY 12.1
The ARC and NH&MRC should continue to be the principal sources of government funds for basic research.

Strategy 12.1.1
FASTS will support less prioritisation for basic research agencies than for applied and strategic research organisations.

Peer-reviewed funding is the primary source for basic research throughout the world. The ideal is to support excellent people and original ideas wherever they may be, but it is also recognised that critical intellectual mass is important in allocating finite resources.

Aggregation and networking of groups can be an effective way of synergising research efforts, but should only be supported where there is a demonstrable advantage.

POLICY 12.2
Peer review is the best mechanism for assessing basic research proposals.

Strategy 12.2.1
Allocate funds on the basis of critical mass where there is a demonstrable advantage.

In recent years, FASTS has advocated significant change in the operation and funding of both the NH&MRC and the ARC. This has helped to bring about initiatives including the establishment of an independent ARC, the awarding of five-year grants and the establishment of larger research programs and centres addressing areas of national priority. The Government has planned to double funding for both the ARC and NH&MRC over a five-year period.

Continuing funding of the ARC and NH&MRC will depend upon demonstrable success, and FASTS sees a strong need for diligent evaluation of the results of this research. Indicators of the value of research include publications, citation rates, patent applications, spin-off companies, increased share value and public good outcomes on the quality of life. FASTS calls for an agreed process for choosing a balanced range of research outcome indicators to perform the challenging task of monitoring the long-term benefits of basic research.

POLICY 12.3
The performance of the ARC and NH&MRC should be monitored to demonstrate to the public the value of investing in their research programs.

Strategy 12.3.1
FASTS will contribute to the process of establishing a broad range of performance indicators.

Strategy 12.3.2
The ARC and NH&MRC should actively publicise the outcomes and quality of their funded research programs.

Despite many changes to the operation and structure of the ARC and NH&MRC recommended by FASTS and others, there remain initiatives that FASTS believes would improve the granting process. A single round of grants still exists for some programs. There are long delays between submission, assessment and announcement of outcomes.

POLICY 12.4
FASTS continues to urge the implementation of best international practice in the administration of the granting processes.

Strategy 12.4.1
Conduct two rounds of fellowship and project applications per year.

Strategy 12.4.2
Streamline assessment processes by adequately resourcing the administration and minimising the time required for ministerial approval.

Strategy 12.4.3
Monitor the salaries of ARC and NH&MRC funded researchers to ensure they are internationally competitive.

The allocation of some research infrastructure funding directly to successful project grants, rather than returning all the research infrastructure funding via the universities, is an alternative model which may ensure that the best research is properly resourced. Furthermore, there are some independent research institutes which do not receive any infrastructure support. These institutes need to have infrastructure funding attached to successful research projects.

However, allocating too great a proportion directly to researchers may lead to erosion of central services such as libraries and computing facilities, for which universities may start charging. FASTS believes that the university system is currently so under-resourced that it will not tolerate such a change (Section 10). If there is a significant increase in resources to the higher education sector, a new approach providing tiers of infrastructure linked to grants (whereby some returns to the investigator and some to the institution) should be considered.

POLICY 12.5
FASTS supports the return of some infrastructure support to the host institution, but believes that this proportion needs to be reviewed.

Strategy 12.5.1
Examine the provision of research infrastructure allocation via universities and increase infrastructure funding for the sector.

Strategy 12.5.2
Address the issue of tying infrastructure funds to grants for independent research institutes that do not receive block grant infrastructure support.

13 Research centres and facilities

In many areas of research, concentrations of activity, networks and collaborative programs can achieve more than the players acting individually. Governments should encourage concentrations of research where such gains can be realised, in particular between universities, federal government agencies, state governments and industry. Examples include the Cooperative Research Centre Program, the world class Centres for Biotechnology and for Information and Communications Technology, and the ARC Centres of Excellence.

POLICY 13.1
Government has a role in supporting partnerships between industry, universities and public sector research organisations.

Strategy 13.1.1
FASTS will encourage strong bipartisan support for the CRC and Centres of Excellence programs on a stable, long-term basis.

The CRC Program has brought about substantial changes in the ways Australian researchers engage in commercially-related collaborative, interdisciplinary activities. The CRC Program has stimulated many effective relationships between industry and research groups, leading to research of commercial or environmental significance, and an impressive number of start-up companies.

FASTS endorses the CRC's success in fostering research collaboration and technology transfer, and welcomes increased support for the Program under BAA. The CRC Program as an essential component of a multi-faceted innovation strategy. FASTS endorses the Government policy of monitoring the performance of individual CRCs and the CRC Program. High levels of accountability have been an integral component of the success of the CRC Program and should be extended to all Research Centres.

POLICY 13.2
The CRC Program should be continued and monitored for its success in creating partnerships for innovation and commercialisation.

Strategy 13.2.1
FASTS will contribute through its Member Societies to monitoring and proposing future CRCs.

Strategy 13.2.2
FASTS will assist its Member Societies to coordinate applications to government for the establishment of major national facilities.

Large, complex and highly sophisticated laboratory facilities are an essential component of advanced science, along with museums, major collections, and information bases. The need for major facilities is sporadic, sector priorities are sometimes difficult to predict, and international collaborations can arise outside the national planning process.

FASTS therefore recommends that funding of major national research facilities and major national scientific infrastructure becomes a permanent federal budget item, which can be rolled over from year to year. This will allow Australia flexibility to support nationwide initiatives of a world class and visionary nature as they arise.

Major national facilities often cross portfolio boundaries, and government should establish a process to assess submissions against national priorities. The responsibility for this could reside with the Chief Scientist.

POLICY 13.3
Major national science and technology facilities must be supported as important tools for collaborative research.

Strategy 13.3.1
Establish a rolling fund for competitive major national research facilities in the Federal Budget.

Strategy 13.3.2
FASTS will assist its Member Societies to coordinate applications to government for establishment of major national facilities.

14 Government research agencies

In addition to the ARC and NH&MRC, government research agencies more focused on strategic and applied research such as CSIRO, AIMS, Geoscience Australia and ANSTO, provide an important contribution to the Australian research sector. In 2001/2002 the Government invested more than $1.5 billion in these agencies.

It is important that these agencies have appropriately defined functions that complement the research mission of the ARC and NH&MRC. FASTS believes that for these agencies to be effective, their national missions must be underpinned by long-term, core research programs that support innovation and can respond to new scientific challenges. The agencies' core programs must be consistent with national priorities, but it should be up to individual agencies to set priorities within the core programs.

POLICY 14.1
Government research agencies should have well defined missions consistent with national priorities and underpinned by core research programs.

Strategy 14.1.1
Government research agencies should be encouraged to define their core business, in terms consistent with and informed by national priorities.

Over the past decade there has been increasing pressure on agencies to increase external earnings. This pressure has led to an increase in short-term tactical research, which is more likely to be supported by industry, at the expense of the longer-term strategic research. In agencies where the primary outcomes are for the public good, meeting external earnings targets has been more difficult and has resulted in considerable change in the research profile and resource allocation within the organisation.

CSIRO has been particularly affected by its 30% external earnings target. The 1999-2000 Annual Report summarises the situation:

> *"The decline in business investment in R&D over the past few years back to the early 1990 levels of 0.67 per cent of GDP, has made collaboration with Australian industry more difficult particularly in the mining related sectors. Continuing cost pressures on CSIRO for infrastructure and wages have resulted in a reduction of staff numbers by about 1000 since 1990, placing further pressure on the ability to achieve the planned outputs."*

Exernal earnings are currently under review by the Chief Scientist, and FASTS does not argue against them per se. Joint research programs between CSIRO and industry benefit both parties, and in the long run, produce flow-ons that benefit the whole country. However, FASTS will oppose unrealistic targets for external funding for public sector research organisations.

FASTS is concerned that the level of external earnings has become a performance indicator. No clear link has been demonstrated between the level of external earnings and the effectiveness of an organisation in delivering "innovative solutions for industry, society and the environment" as well as wealth and jobs for Australia.

POLICY 14.2
The levels of external earnings should be agency specific, and tailored to achieve the best outcomes for each agency.

Strategy 14.2.1
Lower levels of external earnings should be expected for agencies that have a higher emphasis on public good research.

Strategy 14.2.2
Performance indicators for government science agencies should be based on the economic, social and environmental benefits to the community. The level of external earnings should not be a performance indicator.

CSIRO and other government agencies provide an effective means of addressing a range of strategic national opportunities and needs. Consistent support for such publicly-funded research is essential, particularly in the context of continual internal structural change. Research aimed at short-term economic goals should be the responsibility of the relevant industry.

Government research agencies should be properly funded to achieve their national objectives. Over the last decade, CSIRO for example has lost 12% of its staff and 24% of its

federal funding as a percentage of GDP[36], while ARC and NH&MRC funding is currently in the process of doubling under BAA.

POLICY 14.3
Public sector research agencies must respond to national priorities, but must be provided with sufficient levels and stability of funding to address long-term national goals.

Strategy 14.3.1
FASTS will support triennium-funding arrangements for public sector R&D.

FASTS supports the findings contained in Chapter 7 of the Report of the Productivity Commission on Cost Recovery[37]. The Report commented on cost-recovery through the sale of products and the provision of services:

> *"Government Research Agencies should define a basic set of core information outputs determined by reference to:*
>
> - *Public good characteristics;*
> - *Significant positive spillovers; and*
> - *Other Government policy reasons.*
>
> *These basic information outputs should be funded from general taxation revenue."*

FASTS believes there needs to be a better analysis on the cost effectiveness of research carried out in government agencies. Because these agencies are closer to producing commercial outcomes than more fundamental research oriented bodies such as the ARC and NH&MRC (Section 4), different indicators and a different process may be required.

POLICY 14.4
A consistent methodology is required to evaluate the cost benefits of programs in government research agencies.

Strategy 14.4.1
Government should respond promptly to the recommendations in Chapter 7 of the Productivity Commissions Report on Cost Recovery.

Strategy 14.4.2
A pilot study should be undertaken on the methodology for cost benefit analyses in government research agencies.

36 Letter to The Australian, Paul Wellings, Deputy Chief Executive of CSIRO. About October 25, 2000.

37 Cost Recovery by Government Agencies, Inquiry Report No.15, August 2001, Productivity Commission.

15 Valuing science in the modern economy

Australia needs a cultural change in the way Australians see science and technology, particularly in terms of its importance to business, investment, employment and the environment. The community has a serious interest in issues such as genetically-modified foods, stem cell research and the health implications of mobile phones, as well as a curiosity in the world about them. A climate needs to be developed in which scientific issues can be discussed comfortably, particularly with regard to risk awareness and management.

POLICY 15.1
Informed discussion of science and technology should be encouraged in all sectors of the community.

Strategy 15.1.1
FASTS will contribute to public discussion on science and technology and on risk awareness and management.

Scientists and technologists must become more aware of public issues, and be prepared to inject science into public debate. FASTS will encourage scientists and technologists to take active roles in the community and science education.

POLICY 15.2
Scientists should contribute actively to public debate on scientific issues.

Strategy 15.2.1
Train scientists to communicate their ideas to the public, both directly and through the media.

Strategy 15.2.2
FASTS will encourage its Member Societies to contribute to public discussions on science-based issues.

Strategy 15.2.3
FASTS will encourage its Member Societies to work with representatives of law societies to ensure that balanced expert views are available for the determination of scientific evidence.

Government is in a unique position through a range of portfolios to inform the general public about the importance of science and technology in wealth creation, employment, the community and the environment. FASTS supports government-led public consultations such as the National Priorities process, and consciousness-raising events such as National Science Week and the Prime Minister's Prize for Science.

There is also a need to support measures with a broader outreach, such as science communication programs on the ABC and through CSIRO. It is also important for Government to stimulate debate on moral and ethical issues well before it is forced to legislate in the face of rapid scientific advances.

POLICY 15.3
Government has a clear role in promoting a national program of scientific understanding and awareness.

Strategy 15.3.1
The Government's Innovation Awareness Strategy should be strengthened and extended to coordinate support for science communication by Government-funded organisations such as the ABC and CSIRO.

Strategy 15.3.2
The Government should encourage debate on moral and ethical issues relating to science to inform legislative processes.

Strategy 15.3.3
Research providers such as the ARC and the NH&MRC should include a public awareness program so that the main research activities and the outputs of the research are communicated directly to the public.

There is a role for government in promoting science and mathematics education. This can be achieved by creating attractive career paths with appropriate remuneration, by providing appropriate career advice and by rewarding excellence. It is particularly important for outreach programs provide access to scientists in the school system.

POLICY 15.4
Promotion of science and mathematics in schools is crucial to the nation's appreciation and understanding of science in the modern world.

Strategy 15.4.1
Federal and State Governments must ensure that informed and experienced career advisors in science and mathematics are accessible to all school children.

Strategy 15.4.2
FASTS will encourage the adoption of retired scientists and mathematicians as school mentors with Government training and assistance, as well as the participation of young practising scientists.

Strategy 15.4.3
Encourage education authorities to support achievement through excellence, such as the science and mathematics Olympiads.

There is a pressing need for a high level of scientific and technological literacy in the boardrooms and senior management of the private and public sectors in Australia. Business and industry need to play a more active role in recruiting young scientists and in promoting more widely the benefits of investment in science.

POLICY 15.5
Business and industry should actively promote science as a key element of wealth creation.

Strategy 15.5.1
Highlight successful industries and entrepreneurial scientists through prizes, awards, publications, media and open days.

Strategy 15.5.2
Improve the knowledge of science in business and industry, for example, by incorporating science courses in MBA programs.

Strategy 15.5.3
Encourage companies to appoint scientifically and technologically trained people at board level.

It is also a responsibility of scientists, educators and government to resist the dissemination of pseudo-science, such as astrology or creationism.

POLICY 15.6
The promulgation of pseudo-science should be resisted and should not be given equal time to science in schools.

Strategy 15.6.1
FASTS will work with its Member Societies, educators and other scientific bodies to resist the promotion of pseudo-science.

16 Scientific advice to Parliament

In the modern economy where scientific and technological issues play an increasingly central role, the provision of accurate, timely and well-balanced scientific advice to Parliament is becoming more important than ever. Science and technology is central to Government policy making, and Parliamentarians need accurate and timely scientific advice.

The expertise in Federal departments needs to complemented by advice from a number of other sources. These include the Office of the Chief Scientist (via PMSEIC) and the Parliamentary Standing Committee on Science and Innovation, as well as direct interactions with practising scientists through FASTS' "Science meets Parliament" Day and the proposed Parliamentary Fellowship Scheme.

Chief Scientist

FASTS sees a continuing central role for the Chief Scientist who, with cross-portfolio knowledge and a neutral stance, can advise the Government, its agencies and funding bodies. The position of the Chief Scientist should be full-time. Not only is the scope of the responsibilities of the Chief Scientist immense, but having a full-time Chief Scientist sends a clear message of the importance that government places on this role. FASTS believes the position should be restored to the Department of Prime Minister and Cabinet to facilitate a whole-of-government approach.

POLICY 16.1
FASTS strongly supports the continuation of the office of Chief Scientist.

Strategy 16.1.1
FASTS will press for a full-time role for the Chief Scientist within the Department of Prime Minister and Cabinet.

Standing Committee on Science and Innovation

The recently established Parliamentary Standing Committee on Science and Innovation – an initiative championed by FASTS – provides a permanent forum in Parliament for the examination of key scientific issues. While many of these may deal with science at the cutting edge (such as stem cell research or global warming), there are also other issues of a policy nature which the Committee should consider in a watchdog role. An example is the decline in the number of school science and mathematics students and the capacity to teach in the enabling sciences.

POLICY 16.2
The Parliamentary Standing Committee on Science and Innovation should be a permanent forum that informs Parliament on timely scientific issues.

Strategy 16.2.1
FASTS will work with its Member Societies to provide important topics for consideration by the Committee.

"Science meets Parliament" Day

The introduction by FASTS in 1999 of a day of face-to-face meetings between hundreds of scientists and Parliamentarians has become a major event on the scientific calendar. SmP day represents a unique opportunity for Parliamentarians to have one-on-one discussions with scientists from around the country. The success of this event has been recognised by a Government funding contribution to SmP Day for 2002 – 2004.

POLICY 16.3
Science meets Parliament Day should continue to play a key role for discussion of scientific issues in the Parliament.

Strategy 16.3.1
FASTS will continue to commit its own resources and will strongly support the participation of its Member Societies to ensure that SmP Day remains a valuable contribution to the advancement of scientific issues.

Parliamentary Fellowship Scheme

Unlike some countries, Australia has not benefited from the high mobility of scientists between different sectors of the economy. There is no opportunity for scientists in academia, industry or government research organisations to provide the full-time benefit of their knowledge to the Australian Parliament.

FASTS proposes the adoption of a Parliamentary Fellowship Scheme whereby scientists are

recruited to work for a year within Parliament, attached to a Committee or to other areas. The aim of the scheme would be to increase sources of scientific advice and expertise within the Parliamentary system.

POLICY 16.4
Strengthen scientific advice to Parliament through the establishment of a Parliamentary Fellowship Scheme.

Strategy 16.4.1
FASTS will work with officers of the Australian Parliament to develop a bipartisan model for a Parliamentary Fellowships Scheme, and will assist its Member Societies to identify and prepare candidates.

17 Scientific and technological societies

FASTS has 60 members, almost all of them learned or professional societies. These societies in turn have 60,000 individual scientists and technologists as members. These societies play a crucial role in supporting the professional development of their members via education, training, mentorship, accreditation, definition of codes of conduct and communication between members and with the public. Such societies also facilitate an international profile for Australian science within their disciplines. Nationally the profile of science and technology benefits from a wider representation through an overarching body like FASTS.

POLICY 17.1
FASTS will serve its Member Societies by acting as a peak body for science and technology in Australia.

Strategy 17.1.1
FASTS will continue to represent its Member Societies on PMSEIC, through SmP day, and in direct discussions with the Parliament, the public service and other organisations with an interest in science and technology.

Strategy 17.1.2
FASTS will continue to publish Occasional Papers and hold national Forums that highlight scientific and technological issues.

On occasion, Australian professional scientific societies have the opportunity to host international conferences in Australia. Such meetings are extremely important for showcasing Australian science, establishing global scientific networks and demonstrating new technologies to business and industry. However, such bids are often expensive to launch and attract significant risk.

POLICY 17.2
The hosting of international scientific meetings in Australia is important for establishing globally networks and visibility.

Strategy 17.2.1
Government should provide greater support for bids by societies to host international conferences.

The structural and legal obligations placed on societies can be onerous, as most are non-profit entities operated by volunteers. FASTS will undertake a program to build the capacity of its member societies. The workshops will build on skills and experience within the societies and assist them to perform their valuable role efficiently and responsibly.

POLICY 17.3
Maintaining the operational effectiveness of scientific and technological societies is a national benefit.

Strategy 17.3.1
FASTS will enhance the effectiveness of Member Societies by running capacity-building workshops on a national basis.

Many non-profit organisations are being crippled by increasing indemnity and public liability insurance costs. This includes societies that often have low subscription rates and small memberships that make the costs of such insurance prohibitive. Members of societies whose professional activities involve field trips are also finding that such insurance costs are limiting these core activities.

POLICY 17.4
The effect of indemnity insurance on professional activities must be addressed as a matter of urgency.

Strategy 17.4.1
FASTS will represent the case for limiting insurance costs to Government and to peak insurance organisations.

Australian scientists have an obligation to uphold the highest standards of conduct and public accountability in both teaching and research. Professional societies have a role to play in this by implementing ethical standards and codes of conduct for their members, and in ensuring that processes for reviewing these standards are actively maintained in the organisations that employ them.

POLICY 17.5
Australian researchers and educators must operate under the highest standards of professional and ethical conduct.

Strategy 17.5.1
FASTS will work with its Member Societies to ensure that organisations have codes of conduct that maintain the highest professional standards.

Glossary of acronyms

ABC	Australian Broadcasting Commission
ABS	Australian Bureau of Statistics
AIDS	acquired immune deficiency syndrome
AIMS	Australian Institute of Marine Science
ANU	Australian National University
ANSTO	Australian Nuclear Science and Technology Organisation
ARC	Australian Research Council
AVCC	Australian Vice Chancellors Committee
BAA	*Backing Australia's Ability*
BCA	Business Council of Australia
BERD	Business Expenditure on Research and Development
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CGT	Capital Gains Tax
EU	European Union
GDP	Gross Domestic Products
GERD	Gross Expenditure on Research and Development
HECS	Higher Education Contributory Scheme
HIV	Human Immunodeficiency Virus
IIF	Innovation Investment Fund Program
IP	Intellectual Property
ISIG	Innovation Summit Implementation Group
IPRS	International Postgraduate Research Scholarships
NH&MRC	National Health and Medical Research Council
OECD	Organisation for Economic Cooperation and Development
PDF	Pooled Development Fund
PIIP	Pharmaceutical Industry Investment Program
PMSEIC	Prime Minister's Science, Engineering and Innovation Council
R&D	Research and development
SME	Small to medium-sized enterprises
S&T	Science and Technology

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